1   1. A method of reading information characterized by comprising \

2   steps of:

3   one-dimensional arrangement;

4   extracting information concerning an elemental unit

5   length of the information length of the binary digit information

6   from the acquired signal; and

7   reading a ratio of the binary digit information to the

8   information length based on the extracted elemental unit length

9   information.

1   2. A method of reading information according to Claim 1,

2   characterized in that the elemental unit length information is

3   extracted as an elemental frequency information corresponding

4   to the elemental unit length, a band limiting processing is

5   effected on the acquired signal based on the extracted elemental

6   frequency information, and thereafter the ratio of the

7   information length of the binary digit information is read.

1   3. An information reading apparatus characterized by

2   comprising:

3   a signal acquiring unit for acquiring from a medium, a

4   signal containing binary digit information having a

5   predetermined information length and an arrangement;

6   an elemental frequency extracting unit for extracting an

7   elemental frequency corresponding to an elemental unit length

8   of the binary digit information of the information length from

9   the acquired signal;

10   a band limiting unit for limiting a frequency band of the

11   acquired signal based on the extracted elemental frequency

12   information;

13   a timing point extracting unit for extracting a timing

14   point which is in synchronism with the acquired signal and has

15   the elemental frequency, based on the acquired signal and the

16   elemental frequency information;

17   an amplitude extracting unit for extracting an amplitude

18   value of a signal from the band limiting unit in accordance with

19   the timing point extracted by the timing point extracting unit;

20   a tri-state value generating unit for generating tri-state

21   value data from the amplitude values extracted by the amplitude

22   extracting unit in accordance with the timing point; and

23   a reading unit for reading a ratio of the binary digit

24   information to the information length by calculating the

25   tri-state value data generated by the tri-state value generating

26   unit.

1   4. An information reading apparatus according to Claim 3,

2   characterized in that the signal acquiring unit comprises a

3   photoelectric converting unit for receiving a ray of incident

4   light and converting the received ray of light into an electric

5   signal based on the photoelectric conversion, a determining unit

6   for determining whether the electric signal supplied from the

7   photo-electric converting unit derives from photo-electric

8   conversion effected on the ray of light reflected on the medium

9   or not, and a gate unit arranged to respond to the result of

10   determination of the determining unit in such a manner that if

11   it is determined that the signal component derives from

12   photoelectric conversion effected on the reflected ray of light

13   then the signal component is acquired as the acquired signal

14   while if it is determined that the signal component derives from

15   photoelectric conversion effected on any ray of light other than

16   the reflected ray of light then the signal component is excluded

17   from an object of a signal to be acquired.

1   5. An information reading apparatus according to Claim 4,

2   characterized by an arrangement such that the determining unit

3   is supplied with a signal deriving from conversion from an analog

4   signal status to a digital signal status effected on the electric

5   signal from the photoelectric converting unit, and the

6   determining unit determines whether the signal derives from

7   photoelectric conversion effected on the ray of light reflected

8   on the medium or not.

1   6. An information reading apparatus for reading information

2   from a medium having a mark representing a data group composed

3   of a predetermined number of pairs of information elements, each

4   of the information elements being composed of a white region

5   and a black region disposed alternately with a certain width

6   arranged to have an association with coded data, the information

7   reading apparatus acquiring the data group information as an

8   integer number ratio between the data widths of each information

9   element pair, the information reading apparatus comprising:

10   a signal acquiring unit for detecting an analog signal

11   having a variation corresponding to an intensity variation of

12   a reflected ray of light which is caused by scanning the mark

13   on the medium with a ray of light running at a predetermined

14   velocity in the scanning direction, and effecting a sampling

15   operation on the continuous signal at a predetermined sampling

16   frequency to acquire the data group information represented by

17   the mark recorded on the medium in a form of digital signal;

18   an elemental frequency extracting unit for extracting an

19   elemental frequency corresponding to an elemental unit length

20   of the width of the while region and the black region from the

21   acquired signal in the form of digital signal;

22   a band limiting unit for limiting a frequency band of the

23   acquired signal based on the extracted elemental frequency

24   information;

25   a timing point extracting unit for extracting a timing

26   point which is in synchronism with the acquired signal and has

27   the elemental frequency, based on the acquired signal and the

28   elemental frequency information;

29   an amplitude extracting unit for extracting an amplitude

30   value of a signal from the band limiting unit in accordance with

31   the timing point extracted by the timing point extracting unit;

32   a tri-state value generating unit for generating tri-state

33   value data from the amplitude values extracted by the amplitude

34   extracting unit in accordance with the timing point; and

35   a reading unit for reading a ratio of the binary digit

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36 information to the information length by calculating the

37 tri-state value data generated by the tri-state value generating

38 unit, wherein

39   relationship among a width, bar[μm] of the white region

40 or the black region representing the elemental unit length of

41 the binary digit information, the scanning velocity, vmax[m/s]

42 of the scanning ray of light, and the sampling frequency, fs[MHz]

43 can be expressed by the following equation

44      $2 < fs/(2*bar/vmax) \leqq 1$

1   7. A method of acquiring a signal for use with an information ⊔

2   reading apparatus having a signal acquiring unit for acquiring

3   a signal containing binary digit information recorded on a medium

4   so as to have a predetermined information length, the information

5   reading apparatus being arranged to extract information

6   regarding an elemental unit length of the information length

7   of the binary digit information from the acquired signal, thereby

8   to read a ratio of the binary digit information to the information

9   length based on the extracted elemental unit length information,

10 the method of acquiring a signal for use with the information

11 reading apparatus characterized in that

12   the signal acquiring unit acquires a signal containing

13 the signal component and also a component other than one deriving

14 from the medium having the binary digit information recorded

15 thereon, determination is made on the acquired signal so as to

16 identify a signal portion deriving from the medium having the

17 binary digit information recorded thereon by using an amplitude

18 averaging calculation processing, and

19   the signal component deriving from the medium is cut out

20 in accordance with the result of determination, and the cut-out

21 portion is acquired as a signal containing the binary digit

22 information.

1   8. A method of effecting a band limiting processing for use 5

2   with an information reading apparatus having a signal acquiring

3   unit for acquiring a signal containing binary digit information

4   recorded on a medium so as to have a predetermined information

5   length, the information reading apparatus being arranged to

6   extract information regarding an elemental unit length of the

7   information length of the binary digit information from the

8   acquired signal, thereby to read a ratio of the binary digit

9   information to the information length based on the extracted

10 elemental unit length information, the method of effecting a

11 band limiting processing for use with the information reading

12 apparatus characterized in that

13   as a preprocessing for reading the ratio data of the binary

14 digit information to the information length, an elemental

15 frequency corresponding to the elemental unit length is extracted

16 from the acquired signal, and the frequency band of the acquired

17 signal is limited based on the extracted elemental frequency.

1   9. A method of extracting a timing point amplitude for use with 6

2   an information reading apparatus having a signal acquiring unit

3   for acquiring a signal containing binary digit information

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4   recorded on a medium so as to have a predetermined information

5   length, an elementary frequency extracting unit for extracting

6   an elementary frequency corresponding to an elementary unit

7   length of the information length of the binary digit information

8   obtained from the acquired signal, and a band limiting unit for

9   limiting a frequency band of the acquired signal based on the

10   extracted elemental frequency information, wherein a ratio of

11   the binary digit information to the information length is read

12   from the signal having undergone the frequency band limitation

13   in the band limiting unit, the method of extracting the timing

14   point amplitude for use with the information reading apparatus

15   characterized in that

16   as a preprocessing for reading the ratio data of the binary

17   digit information to the information length, a timing point in

18   synchronism with the acquired signal and having the elemental

19   frequency is extracted based on the acquired signal and the

20   elemental frequency information, an amplitude value of a signal

21   from the band limiting unit is extracted in accordance with the

22   extracted timing point, and tri-state value data is generated

23   from the extracted amplitude values in accordance with the timing

24   point.

1   10. A method of reading information from a medium having a mark   7

2   recorded thereon, the mark representing a data group composed

3   of a predetermined number of information element pairs each

4   composed of a white region and a black region each having a width

5   length and disposed alternately on the mark for representing

6   the data group, the method of reading information achieving

7   information reading by acquiring the data group information as

8   an integer number ratio between the width length data of each

9   information element pair, characterized by comprising steps of:

10   scanning a ray of light on the mark at a predetermined

11   velocity to cause a reflected ray of light, detecting a signal

12   having a variation corresponding to an intensity variation of

13   the reflected ray of light deriving from the scanning in the

14   scanning direction, thereby acquiring a signal containing binary

15   digit information corresponding to the intensity variation of

16   the reflected ray of light;

17   extracting an elemental frequency corresponding to an

18   elemental width time of the width data from the acquired signal;

19   effecting band limitation on the acquired signal to obtain

20   an optimum signal band based on the extracted elemental

21   frequency; and

22   reading integer number ratio between the data widths of

23   each information element pair from the acquired signal having

24   undergone the band limitation based on the elemental frequency.

1   11. A method of reading information according to Claim 10,

2   characterized in that each processing from a step of acquiring

3   the detected signal having the intensity variation in the

4   reflected ray of light to a step of reading the integer number

5   ratio between the width length data of each information element

6   pair contains a differential processing characteristic of a time

7   span substantially corresponding to the elemental width time

8   or a time span substantially corresponding to one slightly

9   smaller than the elemental width time.

1   12. A method of reading information according to Claim 10,

2   characterized in that each processing from a step of acquiring

3   the detected signal having the intensity variation in the

4   reflected ray of light to a step of reading the integer number

5   ratio between the width length data of each information element

6   pair contains a differentiating processing characteristic of

7   a gain peak frequency substantially corresponding to the

8   elemental frequency equivalent to the elemental width time or

9   a frequency substantially corresponding to one slightly larger

10 than the elemental frequency.

1   13. A method of reading information according to Claim 12,

2   characterized in that the differentiating processing

3   characteristic is arranged to have a gain characteristic of a

4   cosine equivalent characteristic having a gain peak frequency

5   substantially corresponding to the elemental width time of the

6   width information of the input signal or a gain peak frequency

7   substantially corresponding to one slightly larger than the gain

8   peak frequency whereas the differentiating processing

9   characteristic is arranged to have a phase characteristic tending

10 to vary lineally with respect to the frequency.

1   14. A method of reading information according to Claim 10,

2   characterized in that the step of extracting the elemental

3 frequency is further arranged to comprise steps of:

4   effecting a differentiating processing on the acquiring

5 signal in such a manner that the gain peak frequency is set to

6 a value equal to or larger than the maximum frequency of the

7 acquired signal in a signal acquisition allowable region;

8   effecting a squaring processing on a signal having

9 undergone the differentiating processing;

10   analyzing the result deriving from the squaring processing

11 based on frequency spectrums; and

12   determining that a significant certain frequency except

13 for 0Hz is regarded as the elemental frequency based on the result

14 of analysis using the frequency spectrums.

1 15. A method of reading information according to Claim 10,

2 characterized in that the step of extracting the elemental

3 frequency is further arranged to comprise steps of:

4   effecting a differentiating processing on the acquiring

5 signal in such a manner that the gain peak frequency is set to

6 a value equal to or larger than the maximum frequency of the

7 acquired signal in a signal acquisition allowable region;

8   effecting a squaring processing on a signal having

9 undergone the differentiating processing;

10   analyzing the result deriving from the squaring processing

11 based on frequency spectrums;

12   determining that a significant certain frequency except

13 for 0Hz is regarded as the elemental frequency based on the result

14 of analysis using the frequency spectrums;

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15   effecting demodulating processing on the signal having

16 undergone the squaring processing based on the frequency obtained

17 by the frequency calculation and forming the signal into a vector;

18   removing a high frequency component from the signal having

19 undergone the demodulation and the vector formation;

20   obtaining a phase difference between a signal from which

21 the high frequency component is removed and a signal delayed

22 by one sample time from that signal;

23   calculating a deviation of the elemental frequency in terms

24 of frequency relative to the obtained elemental frequency based

25 on the above-obtained phase difference; and

26   determining that the result obtained by adding the

27 calculated frequency deviation to the obtained elemental

28 frequency is the elemental frequency information.

1   16. A method of reading information according to Claim 10,

2   characterized in that when the signal containing the binary digit

3   information is acquired, the manner of signal acquisition is

4   such that the signal is acquired as a digital signal having

5   undergone sampling operation at a predetermined sampling

6   interval, and as a preprocessing for reading the integer number

7   ratio between the width length data of each information element

8   pair, data number decimation is effected on the digital signal

9   having undergone the signal band limitation in accordance with

10 the elemental frequency information.

1   17. A method of reading information from a medium having a mark

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2   recorded thereon, the mark representing a data group composed

3   of a predetermined number of information element pairs each

4   composed of a white region and a black region each having a width

5   length and disposed alternately on the mark for representing

6   the data group, the method of reading information achieving

7   information reading by acquiring the data group information as

8   an integer number ratio between the width length data of each

9   information element pair, the method characterized by comprising

10   steps of:

11   scanning a ray of light on the mark at a predetermined

12   velocity to cause a reflected ray of light, detecting a signal

13   having a variation corresponding to an intensity variation of

14   the reflected ray of light deriving from the scanning in the

15   scanning direction, thereby acquiring a signal containing binary

16   digit information corresponding to the intensity variation of

17   the reflected ray of light;

18   extracting a timing point containing the width data from

19   the acquired signal; and

20   reading the integer number ratio between the data widths

21   of each information element pair from the mark in accordance

22   with the extracted timing point.

1   18. A method of reading information according to Claim 17,

2   characterized in that when the timing point is extracted,

3   differentiating processing is effected on the acquired signal,

4   a timing point is specified in the signal having undergone the

5   differentiating processing in order that the information length

6 of the binary digit information recorded on the medium can be

7 read, and tri-state value digital information is extracted from

8 the amplitude of the signal having undergone the differentiating

9 processing at every specified timing point.

1 19. A method of reading information according to Claim 17,

2 characterized in that when the timing point is extracted,

3 differentiation processing is effected on the acquired signal,

4 a frequency component corresponding to the elemental width time

5 of the width length data is extracted while the signal having

6 undergone the differentiation processing is handled as an input

7 signal, a periodic signal is generated so as to correspond to

8 the elemental width time while the signal having undergone the

9 differentiating processing is handled as an input signal, and

10 a timing point corresponding to the existing point of the mark

11 width information is specified while the generated periodic

12 signal is handled as an input signal, whereas

13   when the integer number ratio between the width length

14 data of each information element pair is read, an amplitude value

15 is taken out from the signal having undergone the differentiation

16 processing at every specified timing point, and the amplitude

17 value of the signal taken out at every specified timing point

18 is converted into tri-state value digital data.

1 20. A method of reading information from a medium having a mark ᶐ

2 recorded thereon, the mark representing a data group composed

3 of a predetermined number of information element pairs each

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4 composed of a white region and a black region each having a width

5 length and disposed alternately on the mark for representing

6 the data group, the method of reading information achieving

7 information reading by acquiring the data group information as

8 an integer number ratio between the width length data of each

9 information element pair, the method characterized by comprising

10 steps of:

11 scanning the mark with a ray of light running at a

12 predetermined velocity;

13 receiving a ray of light coming from the outside and

14 outputting an intensity variation detecting signal representing

15 the intensity variation of the received ray of light; and

16 determining whether or not the received ray of light is

17 one having scanned the mark and reflected therefrom based on

18 the intensity variation detecting signal; wherein

19 in accordance with the result of determination, a signal

20 reflected on the mark coming from an intensity variation

21 detecting width information medium is acquired as a signal for

22 reading information of the data group as an integer number ratio

23 between the width length data of each information element pair,

24 while any component of the intensity variation state detecting

25 signal other than the component of the ray of light reflected

26 on the mark is excluded from an object of the signal to be acquired.

1 21. A method of reading information according to Claim 20,

2 characterized in that when examination is made to determine

3 whether the received ray of light is one having scanned the mark

4   and reflected therefrom or not, the intensity variation optical

5   signal is subjected to a differentiation processing, the

6   differentiated signal having undergone the differentiating

7   processing is squared, and moving average is calculated on the

8   squared differentiated signal, and

9   an intensity variation state detecting signal part is cut

10 out from the ray of light reflected on the mark based on a value

11 obtained by the method of moving average, whereby the cut-out

12 signal part is acquired as a acquired signal.

1   22. A method of reading information according to Claim 20,

2   characterized by a procedure to be done when examination is made

3   to determine whether the received ray of light is one having

4   scanned the mark and reflected therefrom or not, the procedure

5   comprising steps of:

6   subjecting the intensity variation optical signal to a

7   differentiation processing;

8   squaring the differentiated signal;

9   calculating moving average on the squared differentiated

10 signal;

11   examining whether the extracted maximum value of the moving

12 averages exceeds a first threshold value or not to determine

13 a status of validity for the squared differentiated signal in

14 such a manner that, if it is determined that the maximum value

15 exceeds the first threshold value the differentiated squared

16 signal is regarded as a valid signal while if is determined that

17 the maximum value does not exceed the first threshold value the

18 differentiated squared signal is regarded as an invalid signal;

19   effecting an averaging processing on the differentiated

20 squared signal in a period in which the differentiated squared

21 signal is valid, thereby obtaining an averaged value thereof;

22   extracting the maximum value from the differentiated

23 squared signal in a period in which the differentiated squared

24 signal is valid;

25   calculating the difference between the averaged value and

26 the maximum value of the differentiated squared signal in a period

27 in which the differentiated squared signal is valid;

28   comparing the difference with a predetermined second

29 threshold value to determine a way of acquiring the intensity

30 variation state detecting signal in such a manner that, if the

31 difference is smaller than the second threshold value a portion

32 of the intensity variation state detecting signal corresponding

33 to the aforesaid period is cut out so that only the cut-out signal

34 portion is acquired as an acquired signal while if the difference

35 is larger than the second threshold value the portion of the

36 intensity variation state detecting signal corresponding to the

37 aforesaid period is excluded as an object to be acquired as the

38 acquired signal.

1   23. A method of reading information characterized by comprising \ ϡ

2   a step of acquiring a value from a signal containing binary digit

3   information having a predetermined information length and

4   deriving from information elements arrayed one-dimensionally

5   on a medium at every equal time interval, wherein

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6   when an elemental unit length of the information length

7   of the binary digit information is extracted from the acquired

8   signal, the portion of the signal for extracting the state of

9   the binary digit information from the medium information has

10   a band narrower than that of the characteristic for

11   differentiation based on the equal time interval.

1   24. A method of reading information according to Claim 23,

2   characterized in that the elemental unit length information is

3   extracted as elemental frequency information corresponding to

4   the elemental unit length, the read signal is subjected to

5   band-limitation processing based on the extracted elemental

6   frequency information, and after differentiating processing is

7   effected thereon, a ratio of binary digit information to the

8   information length is read.

1   25. A read signal processing unit comprising:

2   means for acquiring a signal containing binary digit

3   information having a predetermined information length and

4   deriving from information elements arrayed one-dimensionally

5   on a medium and extracting an elemental frequency corresponding

6   to the elemental unit length of the information length of the

7   binary digit information from the acquired signal; and

8   means for effecting a band limiting processing on the

9   acquired signal based on the extracted elemental frequency signal

10   and thereafter extracting boundary information of the binary

11   digit information.

1   26. A read signal processing unit comprising: ᆨレ

2   means for acquiring a signal containing binary digit

3   information having a predetermined information length and

4   deriving from information elements arrayed one-dimensionally

5   on a medium and extracting an elemental frequency corresponding

6   to the elemental unit length of the information length of the

7   binary digit information from the acquired signal; and

8   means for effecting a band limiting processing on the

9   acquired signal based on the extracted elemental frequency signal

10   and thereafter extracting a ratio of the information length of

11   the binary digit information.

1   27. A method of processing a read signal comprising steps of   ᆨ ᄀ

2   acquiring a signal containing binary digit information having

3   a predetermined information length and deriving from information

4   elements arrayed one-dimensionally on a medium, extracting an

5   elemental frequency information corresponding to the elemental

6   unit length of the information length of the binary digit

7   information from the acquired signal, effecting a band limiting

8   processing on the acquired signal based on the extracted

9   elemental frequency signal, and thereafter extracting a ratio

10   of the information length of the binary digit information, the

11   method of processing a read signal carrying out further procedure

12   upon extracting the elemental frequency, the further procedure

13   comprising steps of:

14   effecting a differentiation processing on the signal

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15   acquired from the medium in such a manner that the gain peak

16   frequency is set to a value equal to or larger than the maximum

17   frequency of the acquired signal in a signal acquisition

18   allowable region;

19   effecting a squaring processing on a signal having

20   undergone the differentiating processing;

21   analyzing the result deriving from the squaring processing

22   based on frequency spectrums;

23   calculating a characteristic data having a property

24   inverse to an approximated characteristic data on the result

25   of the frequency spectrum analysis;

26   correcting the result of the frequency spectrum analysis

27   by using the inverse characteristic data obtained by the

28   calculation; and

29   extracting a significant certain frequency except for 0Hz

30   as the elemental frequency based on the result of analysis using

31   the frequency spectrums.

1   28. A method of processing a read signal for use with an

2   information reading apparatus comprising a signal acquiring unit

3   for acquiring a signal containing binary digit information having

4   a predetermined information length and deriving from information

5   elements arrayed one-dimensionally on a medium, and a read signal

6   processing unit for extracting an elemental frequency

7   information corresponding to the elemental unit length of the

8   information length of the binary digit information from the

9   acquired signal, effecting a band limiting processing on the

10   acquired signal based on the extracted elemental frequency signal,

11   and thereafter reading a ratio of the information length of the

12   binary digit information, the method of processing a read signal

13   for use with the information reading apparatus carrying out

14   further procedure upon extracting the elemental frequency by

15   the read signal processing unit, the further procedure comprising

16   steps of:

17   effecting a differentiation processing on the signal

18   acquired by the signal acquiring unit in such a manner that the

19   gain peak frequency is set to a value equal to or larger than

20   the maximum frequency of the acquired signal in a signal

21   acquisition allowable region;

22   effecting a squaring processing on a signal having

23   undergone the differentiation processing;

24   analyzing the result deriving from the squaring processing

25   based on frequency spectrums;

26   calculating a characteristic data having a property

27   inverse to an approximated characteristic data on the result

28   of the frequency spectrum analysis;

29   correcting the result of the frequency spectrum analysis

30   by using the inverse characteristic data obtained by the

31   calculation; and

32   extracting a significant certain frequency except for 0Hz

33   as the elemental frequency based on the result of the frequency

34   spectrums analysis corrected.

1   29. A read signal processing apparatus comprising an elemental   ＼Ｓ

2 frequency extracting unit for acquiring a signal containing

3 binary digit information having a predetermined information

4 length and deriving from information elements arrayed

5 one-dimensionally on a medium and extracting elemental frequency

6 information corresponding to the elemental unit length of the

7 information length of the binary digit information from the

8 acquired signal, and an information length ratio extracting unit

9 for effecting a band limiting processing on the acquired signal

10 based on the elemental frequency signal extracted by the

11 elemental frequency extracting unit and thereafter extracting

12 a ratio of the information length of the binary digit information,

13 the elemental frequency extracting unit comprising:

14 a differentiation processing unit for effecting a

15 differentiation processing on the signal acquired from the medium

16 in such a manner that the gain peak frequency is set to a value

17 equal to or larger than the maximum frequency of the acquired

18 signal in a signal acquisition allowable region;

19 a squaring processing unit for effecting a squaring

20 processing on a signal having undergone the differentiation

21 processing in the differentiation processing unit;

22 a frequency spectrum analyzing unit for analyzing the

23 result deriving from the squaring processing effected by the

24 squaring processing unit based on frequency spectrums;

25 an inverse characteristic data calculating unit for

26 calculating a characteristic data having a property inverse to

27 an approximated characteristic data which results from the

28 frequency spectrum analysis supplied from the frequency spectrum

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29 analyzing unit;

30   an analyzed result correcting unit for correcting the

31 result of the frequency spectrum analysis by using the inverse

32 characteristic data obtained by the calculation by the inverse

33 characteristic data calculating unit; and

34   an extracting unit for extracting a significant certain

35 frequency except for 0Hz as the elemental frequency based on

36 the result of the frequency spectrum analysis corrected by the

37 analyzed result correcting unit.

1 30. An information reading apparatus composed of a signal

2 acquiring unit for acquiring a signal containing binary digit

3 information having a predetermined information length and

4 deriving from information elements arrayed one-dimensionally

5 on a medium and a reading processing unit comprising an elemental

6 frequency extracting unit for extracting elemental frequency

7 information corresponding to the elemental unit length of the

8 information length of the binary digit information from the

9 acquired signal supplied from the signal acquiring unit and an

10 information length ratio extracting unit for effecting a band

11 limiting processing on the acquired signal based on the elemental

12 frequency signal extracted by the elemental frequency extracting

13 unit and thereafter extracting a ratio of the information length

14 of the binary digit information,

15   the elemental frequency extracting unit comprising:

16   a differentiation processing unit for effecting a

17 differentiating processing on the signal acquired from the medium

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18   in such a manner that the gain peak frequency is set to a value

19   equal to or larger than the maximum frequency of the acquired

20   signal in a signal acquisition allowable region;

21   a squaring processing unit for effecting a squaring

22   processing on a signal having undergone the differentiation

23   processing in the differentiation processing unit;

24   a frequency spectrum analyzing unit for analyzing the

25   result deriving from the squaring processing effected by the

26   squaring processing unit based on frequency spectrums;

27   an inverse characteristic data calculating unit for

28   calculating a characteristic data having a property inverse to

29   an approximated characteristic data on the result of the

30   frequency spectrum analysis supplied from the frequency spectrum

31   analyzing unit;

32   an analyzed result correcting unit for correcting the

33   result of the frequency spectrum analysis by using the inverse

34   characteristic data obtained by the calculation by the inverse

35   characteristic data calculating unit; and

36   an extracting unit for extracting a significant certain

37   frequency except for 0Hz as the elemental frequency based on

38   the result of the frequency spectrums analysis corrected by the

39   analyzed result correcting unit.